OCS STUDY
MMS 86-0073

PROCEEDINGS
SIXTH ANNUAL GULF OF MEXICO
INFORMATION TRANSFER MEETING

International Hotel
New Orleans, Louisiana
22-24 October 1985

SPONSORED BY

DEPARTMENT OF THE INTERIOR

MINERALS MANAGEMENT SERVICE

GULF OF MEXICO OCS REGIONAL OFFICE

Arrangements Handled by

Science Applications International Corporation
Raleigh, North Carolina

and

Department of Conferences and Workshops
University of Southern Mississippi
Long Beach, Mississippi

Session: CULTURAL RESOURCE I. CURRENT RESEARCH IN THE GULF OF MEXICO

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Date: October 23, 1985

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Cultural Resources I - Current Research in the Gulf of Mexico: Session Summary

Ms. Melanie Stright
Minerals Management Service

The locations of historic shipwrecks, like any archaeological site, are governed by common factors which lend a certain predictability to their occurrence.

Where historically active shipping areas such as major shipping routes, ports, and harbors coincide with environmental factors such as shoals, reefs, and historic hurricane paths, the probability for locating shipwrecks is high.

The presentation by Mr. James Parrent, Texas A&M University, outlines a study proposal to evaluate these various cultural and environmental factors to predict better where shipwrecks might have occurred in the Gulf of Mexico.

The U. S. Army Corps of Engineers intensively investigated one such high probability area, Mobile Bay, AL, in order to locate any historic resources present within a proposed harbor deepening project area. The Corps of Engineers contractor, Espey, Huston & Associates, conducted an extensive magnetometer survey within the project area and investigated all unidentified magnetic anomalies to determine their source. The results of this investigation were presented by Mr. Clell Bond of Espey, Huston & Associates, and Ms. Dorothy Gibbons of the Corps of Engineers, Mobile District.

After shipwrecks are located, accurate mapping and recording of the site sometimes requires years of intensive effort.

Dr. Glen Williams, Texas A&M University, reported on a high resolution ultrasound underwater triangulation mapping system which allows rapid, accurate mapping of a shipwreck site, even in a blackwater environment. The system utilizes three ultrasound receivers, a stationary ultrasound transmitter, and a mobile transmitter linked to an IBM PC portable computer at the surface. After calibrating the positions of the receivers, the computer can calculate the position of the mobile transmitter through triangulation as it traces objects on the seabed. The rapidness and accuracy provided by this mapping system may make obsolete the present time-consuming and subjective underwater site mapping techniques such as hand sketching and photomosaics.

The locations of prehistoric archaeological sites, like historic shipwrecks, are governed by common factors which make their occurrence somewhat predictable. The cultural resources baseline study for the northern Gulf of Mexico (CEI, 1977) established criteria for predicting prehistoric site locations in the offshore environment. A 1982 study by the National Park Service established sedimentary criteria which would allow site/non-site determinations to be made from core-sized sediment samples in the offshore environment. These two studies provided the baseline data necessary to locate prehistoric archaeological deposits on the OCS. In 1983 MMS funded a study to test the predictive and sedimentary criteria established by the 1977 and 1982 studies. The final results of this 1983 study entitled "Prehistoric Site Evaluation of the Northern Gulf of Mexico: Ground Truth Testing of the Predictive Model" were reported by Dr. Charles Pearson of Coastal Environments, Inc.

Of the types of geomorphic features representing high probability areas for prehistoric site occurrence, only karst areas were not included in MMS's 1983 study. Freshwater springs, which often occur in association with these karst areas, provided not only a water source, but also a concomitant increase in plant and animal food resources for prehistoric man during periods of drier climatic conditions and lower standing sea level. Dr. Ervan Garrison, Texas A&M University, presented a proposal to locate submerged karst features (sinkholes) with associated springs offshore in the eastern Gulf of Mexico using infrared scanners and high-resolution side scan sonar systems. These sinkholes would then be investigated for the presence of associated archaeological deposits.

Coastal Environments, Inc. 1977 *Cultural Resources Evaluation of the Northern Gulf of Mexico Continental Shelf.* Prepared for Interagency Archaeological Services, Office of Archaeology and Historic Preservation, National Park Service, U.S. Department of the Interior. Baton Rouge, LA.

Coastal Environments, Inc. 1982 *Sedimentary Studies of Prehistoric Archaeological Sites.* Prepared for Division of State Plans and Grants, National Park Service, U.S. Department of the Interior. Baton Rouge, LA.

Melanie J. Stright obtained a BA in Anthropology from Ohio State University in 1976. From 1976 to 1978 she was District Archaeologist for the Rawlins District of the Bureau of Land Management in Rawlins, WY. In 1978 she became the staff archaeologist for the Gulf of Mexico Outer Continental Shelf Office, where she has worked on developing the marine archaeology program and geophysical survey requirements for oil and gas related high-resolution surveys. Her current research interests are the archaeological applications of remote-sensing methods, paleoenvironmental reconstruction, and Holocene sea level change.

The Archaeological Significance of Sinkholes in the Eastern Gulf of Mexico

Dr. Ervan G. Garrison
Civil Engineering Department
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Inundated karst features such as sinkholes exist on the Outer Continental Shelf of the Eastern Gulf of Mexico. Terrestrial counterparts of these geological features have demonstrated clear evidence of prehistoric man's association with them, particularly in Western Florida. Holocene occupation of Little Salt Springs and Warm Mineral Springs by Archaic Period peoples is currently under archaeological study at these important sites. Occupation of these sinkhole springs occurred during periods of lowered sea stand. This is especially true for Warm Mineral Springs where Cockrell has dated skeletal remains to over 8500 years before the present (B.P.).

Since large areas of the now inundated Outer Continental Shelf were open to settlement as early as 18,000 years B.P., it is reasonable to assume that sinkhole springs active in the early Holocene should have had similar occupations by nomadic hunting and gathering peoples of this period. Springs are an exception to the scenario of fill by marine transgressional processes by the simple discharge of an amount of fresh water sufficient to offset the hydrostatic pressure of sea water and deposition of current transported sediments. Further, in areas of the Outer Continental Shelf such as that off Western Florida (Figure IIIF.1), sediment starvation regimes active there have resulted in little deposition of sediments like that typically observed in the central and western portions of the Gulf of Mexico.

Location of these submarine sinkhole springs presents a challenge to instrumental techniques typically used for other geophysical and remote sensing purposes. Two promising techniques for the location of submerged springs are (1) infrared scanning of the sea surface in the 8 to 12.5 micron band and (2) acoustical survey of the sea bottom with high resolution side scan sonar systems (100-500KHz). Both these techniques have proven successful in the detection of active and inactive submarine sinkhole springs off Jamaica and Western Florida.

An infrared scanner capable of sensing the sea surface infrared emission radiation in the 8 to 12.5 micron band by use of a mercury cadmium tellutide (trimetal) detector can map sea surface temperature to 0.2°C from an airplane flying at an elevation of 1000 to 2000 feet. To obtain only emission radiation rather than emission plus reflection, it is best to fly just before dawn or at night. A mrad detector will give a ground (sea) resolution of (pixel size) 1 foot by 1 foot when flown at 1000 feet of elevation. Band 6 (10.4 to 12.5 micron) of the Thematic Mapper of Landsat 4 yields only a 30m by 30m pixel size, which is far too large for the detection of submarine springs.

The detection of submarine sinkholes has been successfully accomplished off Western Florida using high resolution side scan sonar and digital recording/playback color depthfinders. A sonograph of such a sinkhole is shown in Figure IIIF.2. With instrumentation such as CTD probes (conductivity-temperature-dissolved oxygen sensors) mounted on ships and submersibles, it is further possible to locate precisely the submarine feature for archaeological exploration. If it is not an active spring, reliance on only acoustical detection gear coupled with precision navigation has resulted in the finding and relocation of such sinks as that shown in Figure IIIF.2.

No extensive investigations of these exciting offshore geological features have been conducted to date. The research discussed here has identified and field deployed these technologies successfully in the location of these sinkholes. Continued research may produce verifiable evidence of prehistoric man's early location and use of these same phenomena.

Dr. Ervan G. Garrison is an archaeologist and a lecturer and associate research scientist of Civil Engineering at Texas A&M University. His research interests include the application of geophysical instrumentation to the study of archaeological problems onshore and offshore. Of particular interest to Dr. Garrison is the clear demonstration of early man's presence on the now inundated continental shelf during the Late Quaternary.

Cultural Resource Investigations of Magnetic Anomalies in Mobile Bay

Ms. Dorothy Gibbens
U.S. Army Corps of Engineers
and
Mr. Clell L. Bond
Espey, Huston & Associates, Inc.

The U.S. Army Corps of Engineers, Mobile District, was authorized in the mid-1960's to examine the feasibility of deepening Mobile Harbor, Alabama. A feasibility report was completed in 1980 recommending channel deepening to 50 ft.

The proposed improvements include the following items: turning basin and anchorage area, transshipment facility, channel deepening to 55 feet at existing 400-ft width, passing lane, upper channel widening, disposal of new work material in Wilson Gaillard Island, and disposal of new work material in the Gulf of Mexico.

In compliance with current federal cultural resources laws and U.S. Army Corps of Engineers regulations, cultural resources investigations were initiated for the Mobile Harbor deepening project in 1982. Work performed in 1982 included archival and historic research on the prehistory and history of the study area, and a remote-sensing survey of all proposed work items. A total of 603 magnetic anomalies were recorded by the survey. However, correlation of magnetic data with side-scan sonar imagery revealed that most of the anomalies were produced by cable, pipe, and other modern ferrous debris.

In 1983, underwater archaeological investigations of the anomalies recommended for evaluation were initiated. One of the anomalous areas located within the limits of the proposed new turning basin proved to be part of the western arm of obstructions built by the Confederate engineers as part of the defenses of the City of Mobile during the Civil War. The remainder of the anomalies investigated in 1983 proved to be modern ferrous debris. Subsequently, in 1984, additional archaeological testing of the obstructions was completed. As a result of the 1984 testing program, the remains of a mid-19th century steamboat, the *Cremona*, and a wooden flat loaded with brick were documented. Additionally, the remains of a third vessel, believed to be the *Carondelet*, also sunk as part of the western arm of obstructions, were encountered. The Confederate obstructions, designated submerged historic site 1Mb28, have been determined eligible for inclusion in the National Register of Historic Places.

During the 1984 field season, three trenches placed at the bow, stern, and amidship of the *Cremona* were excavated. The hull, though broken in several places, was found to be in an excellent state of preservation. The hull was filled to varying depths with brick and other rubble. In addition to documenting the dimensions and construction of the *Cremona*, a trench placed to the north of that vessel identified a simply-constructed wooden flat loaded with brick. The lines of wooden pilings demarcating the western arm of obstructions were also delineated running diagonally from southeast to northwest across the turning basin. Planking and bricks were encountered exposed above the bay bottom at the southern end of the line of obstructions. This material is believed to represent the remains of the *Carondelet*.

In 1985, twenty-one anomalies within and adjacent to the Mobile Harbor Ship Channel were evaluated. Five were no longer in place in their positions as reported in 1982. The remaining 16 were identified as modern ferrous debris. In addition to identifying the anomalies located along the ship channel, the western end of the southern line of obstructions and southern end of the western line of obstructions were delineated by underwater archaeologists and recorded with side-scan sonar, magnetometer, and survey fathometer.

The highly variable environment of Mobile Bay, its considerable different water depths, and especially its potentially hazardous diving conditions, necessitated a flexible approach in terms of field methodology. The techniques and equipment of the investigations were continually refined during the 1983, 1984, and 1985 field seasons. In the areas of investigation, water depths varied from three to over 50 feet, and visibility, while typically limited by extreme turbidity to less than a foot, reached as much as 20 feet in the lower bay. Bottom conditions included mollusk reefs, as well as consolidated and unconsolidated silts and clays. The range of work platforms necessary to meet the various work tasks and Bay conditions included inflatable and rigid-hull skiffs, small steel barges, outboard power work boats, and diesel-powered crew boats. Underwater inspection of the anomalies was conducted using both open circuit SCUBA, as well as a surface-supplied air system.

The investigation of each anomaly involved up to eight steps: 1) Initially, the suspected position of each anomaly, as identified during the 1982 survey, was relocated, using a line-of-sight radio-positioning system, and buoyed; 2) after the positioning, the area was reinspected with the magnetometer to determine the strength, size, shape and characteristics of the magnetic signature; 3) after refining and rebuoying the suspected location, the position was again recorded using both the line-of-sight system and Loran C; 4) the area was then subjected to an initial diver inspection and tactile search; 5) if the divers failed to locate the anomalous object, additional magnet prospections were initiated using a diver-manipulated sensor; 6) after final location was made, a program of systematic probing was used to penetrate bottom sediments, with solid probes being used to penetrate to depths of eight feet and hydraulic probes penetrating up to 20 feet of sediment; 7) excavations were then conducted, depending on conditions, using propwash deflectors, hydraulic dredges and hydraulic jets; 8) where possible, the anomaly source was either then archaeologically documented and/or brought to the surface for inspection and removed from the area.

The Mobile Bay investigations have thus far documented a significant portion of American history, identifying both specific cultural resources of the Civil War as well as providing details of ship and harbor defense construction techniques. The investigations have also provided additional information on the interpretation of magnetic signatures.

Ms. Dorothy Gibbens is a cultural resource specialist with the U.S. Army Corps of Engineers, Mobile District. Obtaining her master's degree from Louisiana State University, she has conducted archaeological investigations in Central America and served with the Louisiana State Historic Preservation Office. For the past seven years, Ms. Gibbens has been with the Mobile District specializing in southeastern prehistory and marine survey archaeology.

Mr. Clell Bond is employed by and directs the cultural resources program of Espey, Huston & Associates, Inc., an engineering and environmental consulting firm headquartered in Austin, Texas. Actively engaged in cultural resources management for the past 15 years, his special interests are in historical and nautical archaeology.

A Computerized High Resolution Underwater Ultrasound Triangulation Mapping System

Dr. Glen N. Williams
Computer Science Department
Texas A&M University
and
Dennis A. Hahn
Shell Oil Company

A computerized high resolution ultrasound underwater triangulation mapping system has been developed for the Institute of Nautical Archaeology. This system determines the position of a mobile ultrasound transmitter using a stationary calibration ultrasound transmitter and three ultrasound receivers. All three receivers and both transmitters are hardlinked to the surface via data lines connected to an IBM PC portable computer. The receivers provide sixteen bits of resolution (1/2 millimeter) to the computer for calibration/triangulation purposes. The computer determines the location of the mobile transmitter at a frequency of ten hertz, time stamps the observations, graphically displays them in real time for shipboard/diver interactive communications, and optionally archives them for future post-processing and analysis.

Of keen interest to nautical archaeologists is the ability to record accurately the visual appearance of their underwater excavations. Currently, the techniques employed range from freehand sketches by underwater artists to more sophisticated stereoscopic photographs and videotaping. However, each of these methods has inherent disadvantages. First, the excavation must be at least partially visible for the artists/cameras to properly operate; in addition, the later translation of individual pictures to large mosaics includes an intrinsic amount of subjectivity by the artist. Finally, and most importantly, the large quantity of time to perform the recording is expensive. An alternative method minimizing both subjectivity and time would improve the efficiency and accuracy of the excavation recording tasks.

One such possible solution is electronic triangulation. By utilizing ultrasound pulses, instead of light, as the (primary) source of information, the stringent visibility requirement intrinsic to artists and cameras is removed. Also, the triangulation computations are performed by computer, thus assuring mathematical objectivity. Lastly, the construction of individual pictures and large mosaics is acomplished in real time during the survey and can be redrawn efficiently after a diving session, thus enabling timely reviews of the excavation progress.

The electronic hardware used with the computerized triangulation system consists of three ultrasound receivers, two ultrasound transmitters, and an integrated circuit control module designed to fit a long slot of an IBM PC portable computer.

The three ultrasound receivers are small objects; they measure approximately one inch in diameter and twelve inches in length. Their purpose is to filter digitally all incoming sound frequencies to detect the ultrasound pulse wave. When a receiver detects the designated ultrasound frequency, the receiver transmits a signal to the control module via an attached coaxial cable, acknowledging the arrival of the pulse.

The stationary ultrasound transmitter has approximately the same dimensions as the receivers. It is also attached to the control module via a coaxial cable. When instructed by the control module, the transmitter emits an ultrasound pulse for the receivers to detect.

The mobile ultrasound transmitter is similar to the stationary transmitter in control attachment and control. However, there exist two major differences. Although the electronics within the mobile transmitter are the same size as the stationary transmitter, the mobile transmitter is housed in a longer body with an attached handle for the diver to grasp; the general shape resembles an oversized revolver. In addition, the mobile transmitter has a small trigger switch with a red light emitting diode (LED) for simple diver/computer communications. The diver presses the switch when he is ready to trace an object, while the computer activates the light when it is ready for an object to be traced.

Lastly, the control module measures the time delays required for the mathematical geometric computations. Upon computer operator control, the control module simultaneously instructs the transmitter to emit an ultrasound pulse and counts the number of elapsed clock cycles until the return signals from the individual receivers are obtained. The counts are maintained in a series of sixteen-bit registers. If the elapsed number of clock cycles exceeds (2**16 - 1), the control module stops the counting process. This condition is hereafter referred to as a flooded gate response; a value of (2**16 - 1) is assigned to the time delay counter, a semaphore signaling the software that a valid time delay was not obtained. When all three time delays have been calculated, the computer control module signals the software of the availability of the delay values.

The computerized triangulation procedure consists of four major components: initialization, data input, point determination, and graphical display. When the program is started, the system geometry (transmitter/receiver relationships) is initialized, either from preset conditions or new survey parameters. The program stores the new parameters and proceeds to the data acquisition phase. On the decision of the operator, the initialization procedure can be re-executed to relocate the position of a receiver or completely establish a new underwater relative coordinate system.

The first phase of the data acquisition cycle consists of the data input. When invoked, this section of code performs a series of polls to the ultrasound transmitters and receivers via the computer control module. First, the mobile transmitter is instructed to emit a pulse. Next, the respective receivers will supply the experienced time delays as the number of clock cycles for the pulse to traverse the water. If a flooded gate response is experienced by any of the three receivers, the program displays an error message on the console and requests that the mobile transmitter emit another pulse. This cycle continues until eventually no flooded gate responses are recorded.

Next, the stationary transmitter will emit a pulse to be detected. Again, the receivers supply the time delays or record flooded gate responses. A series of five valid time delays are averaged to reduce the amount of variability within the observations.

After the time delays between the transmitters and receivers have been established, the position determination routine is invoked. First, the sound travel rate and mass flow vector are calculated using the averaged time delays from the stationary transmitter via the calibration equations. Next, the location of the mobile transmitter is computed by translating the time delays experienced from the mobile transmitter. Then, the calculated coordinates are stored in an archive file for future reference. Finally, control is passed to the graphic display section.

Subsequent to the computation of the location of the mobile transmitter, the calculated point is graphically displayed within the XY-plane of the relative coordinate system in real time for the operator to view.

The computerized ultrasound triangulation mapping system is designed for and implemented on an IBM PC portable computer. The computer software is written in MicroSoft BASIC and is executed in compiled form with an 8087 Math coprocessor. A ten hertz control module sampling rate was experienced with this configuration. While the software was being written at Texas A&M, the hardware was being designed and built by Martin Wilcox of Applied Sonics, Inc. The hardware and software components were generated and debugged independently.

The first version of the computerized triangulation procedure was tested in a swimming pool with the surveyed object being a brick. A following test was performed at a Civil War wreck site in the York River, Virginia, and the system functioned as designed.

A second version of a computerized triangulation procedure is currently being designed with modifications to both hardware and software components. The stationary ultrasound transmitter and three ultrasound receivers will be replaced by four ultrasound transducers, capable of both transmitting and receiving ultrasound pulse waves.

The computerized ultrasound triangulation mapping system is a more feasible and economically better system of recording the physical characteristics of underwater excavations than are artist's sketchings and stereoscopic photography. This has been proven by the ease of operation of the mapping system during the preliminary tests. However, as with any new developments, future research can greatly aid the evolvement of the computerized triangulation system. In addition, sensitivity and parametric tests are required to establish the limits of the software and hardware components.

Dr. Glen Williams is an associate professor of computer science at Texas A&M University. His primary areas of interest include computational algorithms in numerical methods and computer graphics and their applications to the oceanic engineering environment. Contributional areas include surface/sub-surface oil spill transport and diffusion, submarine slope stability and geologic process simulation and modeling. He received his BS, ME, and PhD degrees in Civil Engineering from Texas A&M University.

Evaluation of Minerals Management Service Archaeological Management Zone 1

Mr. James Parrent
Department of Anthropology
Texas A&M University

Archaeological studies are conducted in the Gulf of Mexico (GOM) as part of the offshore oil and gas leasing program because of the great number of historic shipwreck sites located there. Accordingly, the Minerals Management Service (MMS) Manual for Archaeological Resource Protection (draft) requires that archaeological baseline studies be updated as new data become available. These baseline studies, containing predictive models which deal with the location of both prehistoric and historic cultural resources, are the foundation for MMS decisions on where to invoke the archaeological survey requirement. No systematic evaluation of historic archaeological resource data has been accomplished since Coastal Environments, Inc., (CEI) completed a report titled "Cultural Resources Evaluation of the Northern Gulf of Mexico Continental Shelf (CEI 1977)." The CEI study was utilized by MMS to establish the present cultural resource management zones.

The present study will compile information collected since 1977 and will consider additional factors which contribute to site location and preservation on the GOM Outer Continental Shelf (OCS). It is anticipated that the present study will more clearly define historic archaeological resource areas on the GOM OCS, thereby avoiding costly surveys in areas where the potential for archeological sites is low.

Volume II of CEI's 1977 report addresses the historic cultural resources which may be found on the GOM OCS. Questions concerning the validity of certain aspects of this volume and the archaeological management program on the OCS have been raised by industry, Gulf Coast State Historic Preservation Officers, the Sierra Club, and the professional archaeological community. Industry, for example, has expressed concern over the amount of money and effort spent on the required lease block surveys in Archaeological Management Zone 1 (AMZI) versus the sparsity of information gained about historic shipwrecks. Another point was raised by the Sierra Club when they responded to the call for comments on the Draft Environmental Impact Statement (DEIS) for 1984. They questioned the following statement in the DEIS: "Due to the general lack of a data base for OCS cultural resources, the expected impact from offshore development is uncertain." In their written response, the Sierra Club asked (1) "What are you going to do about the lack of a data base for OCS cultural resources?" and, (2) "How will you alleviate this problem?" (MMS 1983).

Archaeologists from academia, federal agencies, and state agencies have raised the following questions: (1) Why has so little information about historic shipwrecks been recovered from the lease block surveys in Zone 1? (2) In view of what is known about GOM prevailing wind and ocean current directions, are the sailing routes depicted in CEI's report accurate? (3) How do factors such as bottom sediment types, depth of unconsolidated sediments, water depth, and energy zones affect the state of preservation and integrity of shipwreck sites? (4) Why does the Zone 1 boundary follow, for the most part, the 20-m bathymetric curve, disregarding the influences of such major ship concentrating factors as important historic ports, major harbors, and inland waterways? (5) What is the correlation between historic shipping lanes and historic hurricanes, and how has this correlation affected the shipwreck pattern in the GOM? These questions plus others will be addressed by the present study.

The question about the lack of historic shipwrecks found as a result of lease block surveys can be explained by the fact that industry chooses to avoid almost all magnetic anomalies located during the surveys rather than identifying them. Other questions are not so easily answered. However, new data germaine to the issues are available. For example, preliminary investigation of GOM prevailing wind and currents, coupled with a review of historic maps, suggests that historic shipping routes were different than previously thought. However, it must be emphasized that many maps and historic documents must be examined before any conclusions are reached by the present study.

Another question deserving attention is whether or not shipwrecks will be preserved in high energy zones in the GOM. Claims by some that historic shipwrecks, in areas of high energy, will be scattered and of minimum historic value are not supported by recent investigations. In August 1984, an historic shipwreck located in the GOM Eastern Planning Area was investigated by MMS personnel. Site reports, on file at the Florida Division of Archives, History, and Records Managment Office in Tallahassee, show that, when first discovered, the shipwreck was very well preserved, even though it was in an area of high energy (Parrent 1984). It is well documented that preserved historic shipwrecks can be found in very high energy zones (Arnold and Weddle 1978, Bass 1975, Hoyt 1984, and others). However, before conclusions can be reached by the present study, environmental conditions in the various areas of the GOM must be examined thoroughly to determine their role in the preservation or destruction of shipwreck sites.

Clearly there remains a need to examine the various factors affecting the occurrence and preservation of historic shipwreck sites. These factors need to be analyzed, weighed, and developed into a framework which will assist in determining where the most probable locations of preserved sites are on the OCS. This new and comprehensive approach may lead to recommendations for changing the boundary of AMZ1 in the GOM. In general, archaeologists would like to see the area of Zone 1 increase while other individuals would like for the area to decrease or perhaps not to exist at all. Only through rigid scientific investigation can the concerns of industry, as well as those of the archaeological community, be addressed. Ideas or boundaries not supported by scientific data will always be open to criticism.

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Parrent, James M. New ground reef shipwreck investigations in the eastern Gulf of Mexico. Proceedings Fifth Annual Gulf of Mexico Information Transfer Meeting: 1984, pp. 451-54. MMS GOM OCS Regional Office, Metairie, Louisiana. 1984.

Mr. Parrent is a research scientist/archaeologist with the Department of Anthropology at Texas A&M University. For the past year he has been working with the Minerals Management Service Gulf of Mexico Region through an Interagency Personnel Agreement. Mr. Parrent's responsibilities included the re-evaluation of the historic cultural resource zone in the Gulf of Mexico. He received the BA in Anthropology from Wright State University, and the MA, specializing in nautical archaeology, from Texas A&M University.

Evaluation of Prehistoric Site Preservation on the Outer Continental Shelf: The Sabine River Area, Offshore Texas

Dr. Charles Pearson
Coastal Environments, Inc.
and
Louisiana State University

For the past decade there has been an increasing interest in the prehistoric cultural resources potential of the continental shelves of the world. Many would agree that given certain conditions, prehistoric sites established on the continental shelf during periods of lower sea stand would have withstood the effects of rising seas and now remain preserved on the submerged portions of the shelf. One of the settings which provides that set of conditions conducive to site preservation is a filled stream valley -- especially the larger valleys which with sea level rise develop into estuaries and slowly fill with sediments before being completely inundated. Archaeological deposits can become covered by and encapsulated in estuarine sediments and remain intact beneath the erosive impacts of transgressive seas. Developing statements concerning the occurrence and distribution of archaeological deposits in these offshore settings requires, first, the projection of a culture history for the area with its attendant settlement patterns probably best drawn from onshore analogies; second, an assessment of the geologic history of the area; and third, the identification of the geomorphic processes which have occurred relative to their effect on archaeological site preservation.

To date several studies relying on these types of data have produced what appear to be reasonable models of site occurrence and preservation in large stream valleys on the North American continental shelf (Belknap and Kraft 1981; Coastal Environments, Inc. 1977; Kraft Belknap and Kayan 1983; Masters and Fleming 1983). Testing these models, however, is another and more complicated problem. It requires a technology that permits the identification of submerged and buried landforms which have a high likelihood of containing cultural remains and it also requires a method for collecting samples from these landforms. In essence it demands a practical geological/geophysical approach to an archaeological problem. Fortunately, this technology is today available in the form of a variety of instruments which permit refined mapping of the shallow subsurface geology and in a range of coring devices which can collect an analyzable sample from a submerged target landform.

This paper discusses a project undertaken by Coastal Environments, Inc., to test a predictive model of site occurrence and preservation developed in an earlier baseline study of the cultural resources potential of the OCS (Coastal Environments, Inc. 1977). This project is being sponsored and funded by the Minerals Management Service of the Department of the Interior.

The project was conducted in two phases. The first phase involved the collection, evaluation, and synthesis of archaeological, geological, seismic, and bore hole data from the study area. The second phase involved the collection and analysis of vibracore samples taken from target areas which had been identified from the seismic records as potential cultural resource locales.

The region selected for implementation of this study is a 35-mile-square area in the offshore Sabine-High Island region of eastern Texas and western Louisiana containing the relict- filled channels of the late Pleistocene to Holocene age Sabine River Valley (Figure IIIF.3). This late Pleistocene river system provided an ideal research universe for the present study largely because a series of published works is available which provides information on the present setting and geologic history of the trench area. Of particular importance is the published work of H. F. Nelson and E. E. Bray (1970) which delineates the Pleistocene river system and the subsequent changes it underwent with sea level rise. In addition to the work of Nelson and Bray, an extensive body of seismic and bore hole data collected relative to oil industry activities is available from the area, and the regional geology has been well studied (Aronow 1971; Aten 1983; Bernard 1950; Bernard and LeBlanc 1965; Bernard LeBlanc and Major 1962; Berryhill 1980; Curray 1960; Nelson 1968).

Other factors which make the buried Sabine Trench conducive in the search for submerged sites are (1) the river system was active and the region was subaerially exposed when prehistoric populations occupied the region; (2) the river system was active for at least 12,000 years, sufficient time to permit the accumulation of an extensive archeological record, possibly including multicomponent, stratified sites; (3) relict features having a high probability for both site occurrence and preservation had been identified within the valley system; and, (4) importantly, these landforms are often not deeply buried and many are within the range of vibracoring, the sampling technique used in this study.

Working from the base provided by Nelson and Bray, we have augmented and refined their model of the geology of the area using previously collected seismic and bore hole records. Information from over 100 lease block surveys, 23 pipeline rights-of-way surveys, and 35 borings were examined. An extensive amount of additional seismic data was collected within the study area in an effort to locate and map accurately landforms on which archaeological sites may occur. Added to this were 77 vibracores taken at five high probability locales. Samples were taken from these vibracores in an effort to refine further the local geology and to test for cultural deposits. Types of analytical techniques conducted included radiocarbon dating as well as grain size, point count, pollen, foraminifera, and geochemical analyses.

In every case, vibracores struck the target landsurfaces within one to three feet of the suspected depth derived from the seismic records. This indicated accuracy in terms of positioning and provided a satisfying measure of reliability in terms of our interpretation of features the seismic records.

The analysis of all of the collected seismic and core data has provided information on the geologic history of the study area and its archaeological potential. In most respects our findings correspond closely to those developed by Nelson and Bray relative to the configuration and age of the buried Sabine Trench. A major departure from Nelson and Bray is our identification of extensive areas of relict Deweyville floodplain within the Sabine Trench area.

On seismic records Deweyville surfaces usually appear as an initial hard reflector beneath which there is a void or little indication of variability in the sediments. This signal is distinctly different from that produced by the earlier Prairie/Beaumont Pleistocene features. The Prairie/Beaumont terrace is characterized by distinctive multiple parallel reflectors through which the pinger generally achieved considerable penetration, up to 100 feet.

The features identified from seismic and bore hole data have been interpreted through correlation with the known on-shore Sabine system. The data demonstrate that extensive areas of buried late Pleistocene/early Holocene landforms are preserved in the offshore study area. Many of the offshore settings identified are known on the basis of onshore archaeological data to be locales commonly associated with prehistoric settlement.

It is impossible here to discuss all five offshore areas from which vibracores were taken in the search for evidence of cultural activity. Rather a brief discussion of one of the locales is presented. The location discussed is about ten miles offshore in lease block Sabine Pass 6, along the eastern side of the former Sabine River valley. Figure IIIF.4 presents a plan view of the area derived from the seismic records. Contour lines are in feet below the seafloor to the identified Deweyville surface. The track of the seismic survey vessel and vibracore locations are also shown in Figure IIIF.4.

The basal deposits consist of Deweyville terrace clays and, in the stream and the modern Sabine Valley, pre-transgressive freshwater organic deposits. Immediately above these organic deposits is a fluvial silty clay facies which is interpreted as a submarine, possibly subaerial, river mouth deposit. Blanketing this deposit is a thin stratum of sandy to silty clay, heavily burrowed and containing numerous *Rangia cuneata* shells. The shells exhibit minimal wear, so disturbance has not been great. Foraminifera species in this deposit indicate moderate salinities. This facies is interpreted as a low-energy, transgressive deposit, probably formed with the initial expansion of estuarine systems into the area. The conditions when this stratum was formed were evidently conducive to *Rangia* growth. This blanketing disturbed zone was noted in all of the areas examined and is critical in marking the boundary of transgression. Archaeological materials are expected to be found primarily within or beneath this deposit.

Above this initial transgressive facies is a massive deposit of gray clay which represents bay/estuarine fill. The massiveness and homogeneity of this deposit suggest relatively rapid sedimentation. The uppermost stratum in the section consists of heavily-burrowed clay containing varieties of marine shell. This facies represents modern open gulf seafloor deposits.

The areas of critical importance are the organic deposits which rest atop the Deweyville terrace bordering the filled stream. These, shown in black, were contacted by three cores. Pollen samples from these deposits contain a high percentage of grasses and a diversity of arboreal types suggesting an upland/swamp interface. Point count analysis of samples from these deposits produced large quantities of charred wood and vegetation, nut hulls, seeds, fish scales, and bone. Much of the bone is carbonized and some is definitely calcined. In addition to fish bone are fragments from reptiles and other small animals. The quantity of bone fragments is extremely high. Some of the samples produced projected counts of over 700 fragments of bone per kilogram of sample.

The critical question of course is whether these are or are not cultural deposits. In the very small samples collected, we did not anticipate that finding an identifiable artifact would be a high probability. Rather, it is the sedimentary character and content of the deposit which are most likely to be useful in making this assessment. The basis against which a decision can be made as to the "siteness" of a deposit are the results of an earlier study by Coastal Environments which attempted to identify, through several types of analyses, the characteristics of coastal archaeological site deposits relative to natural deposits (Gagliano et al. 1982). That study indicated that the simple particle content, derived from point counts, provided useful parameters for distinguishing coastal archaeological sites from non-sites. We know of no other data set which provides the necessary comparative model for making this assessment.

That earlier study indicated that the simple co-occurrence of certain components in particular size fractions could be used to distinguish cultural from non-cultural deposits at a statistically reliable level. Owing to space limitations, only the quantitative results of the point count analyses are discussed here. In the two size fractions examined (-1 phi and 0 phi), the critical element for distinguishing between cultural and non-cultural deposits was the simple occurrence of bone alone or the presence of bone and charred organic material. These results suggest that the organic deposit in Sabine Pass 6 has a high probability of being a cultural deposit. Based on that previous model, that probability is very high, ranging from 88 to 100%.

We do, however, question the strength of this identification because of limitations in our comparative model. That model did not encompass all possible non-cultural coastal settings. Particularly relevant here are buried peat and organic deposits. Studies in coastal Louisiana indicate that bone can occur in these deposits, although in small quantities, and apparently no evidence of burned bone has been reported (Coleman 1966). The knowledge that bone can occur in buried natural deposits weakens the argument that the material is cultural; however, this may be offset by the presence of burned bone, the quantity of which seems to be inordinately high to be a natural occurrence. Thus we are left with the situation that while the deposit is suspected of being cultural in origin, we are unable to quantify that likelihood because of the narrowness of our comparative model.

Several other locations within our study area produced similar tantalizing examples of possible cultural remains. While the indicators for these being truly cultural in origin are strong in all cases, there is room for question. The results of geochemical analyses, not yet finalized, may allow for a more definitive identification.

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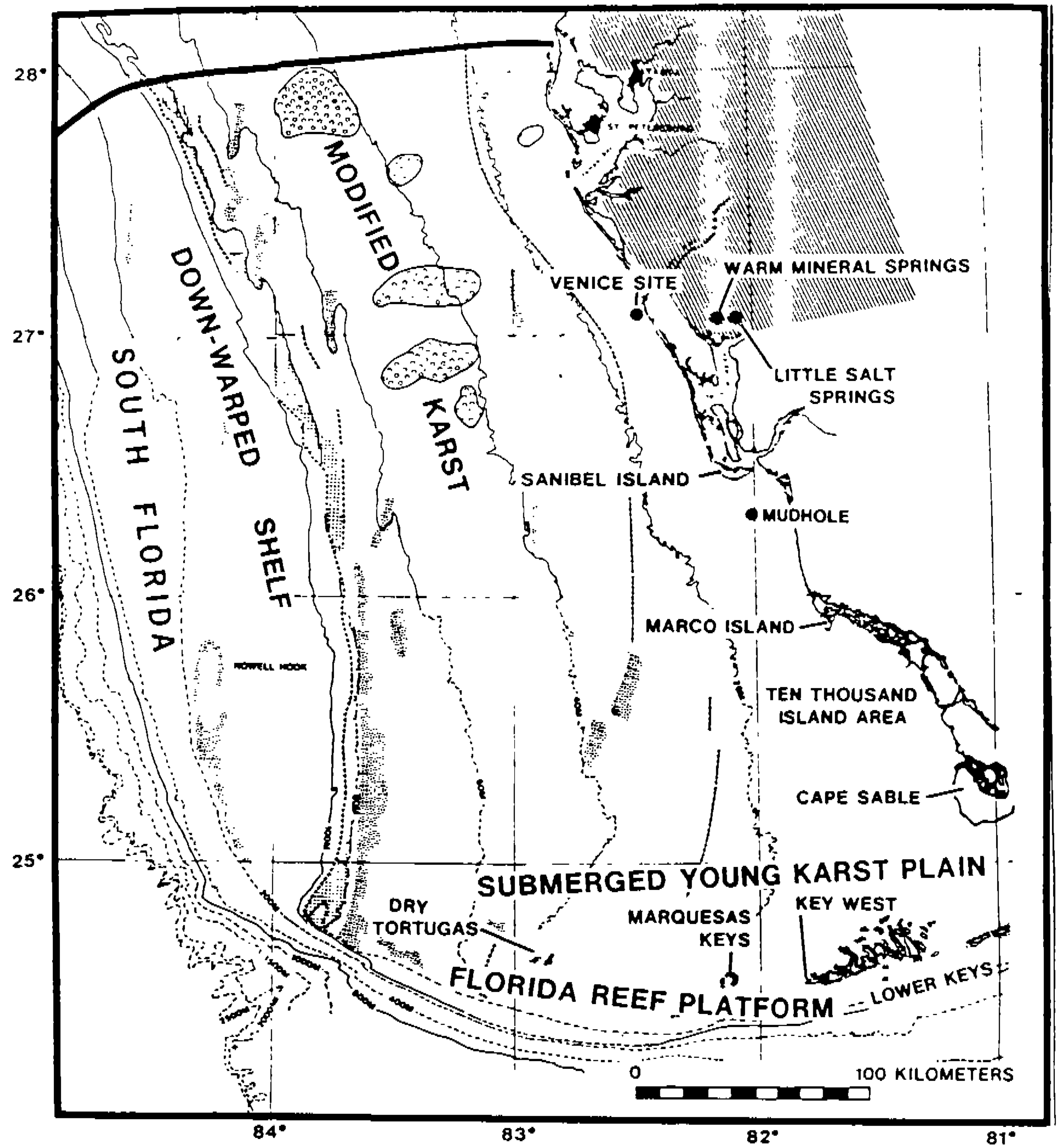

Figure IIIF.1 - Karst Plain-Western Florida Shelf

SONOGRAPH OF 96 FATHOM SINKHOLE, EASTERN GULF OF MEXICO, OCS 50/100 METER SCALES

Figure IIIF.2 - Sonograph of 96 Fathom Sink

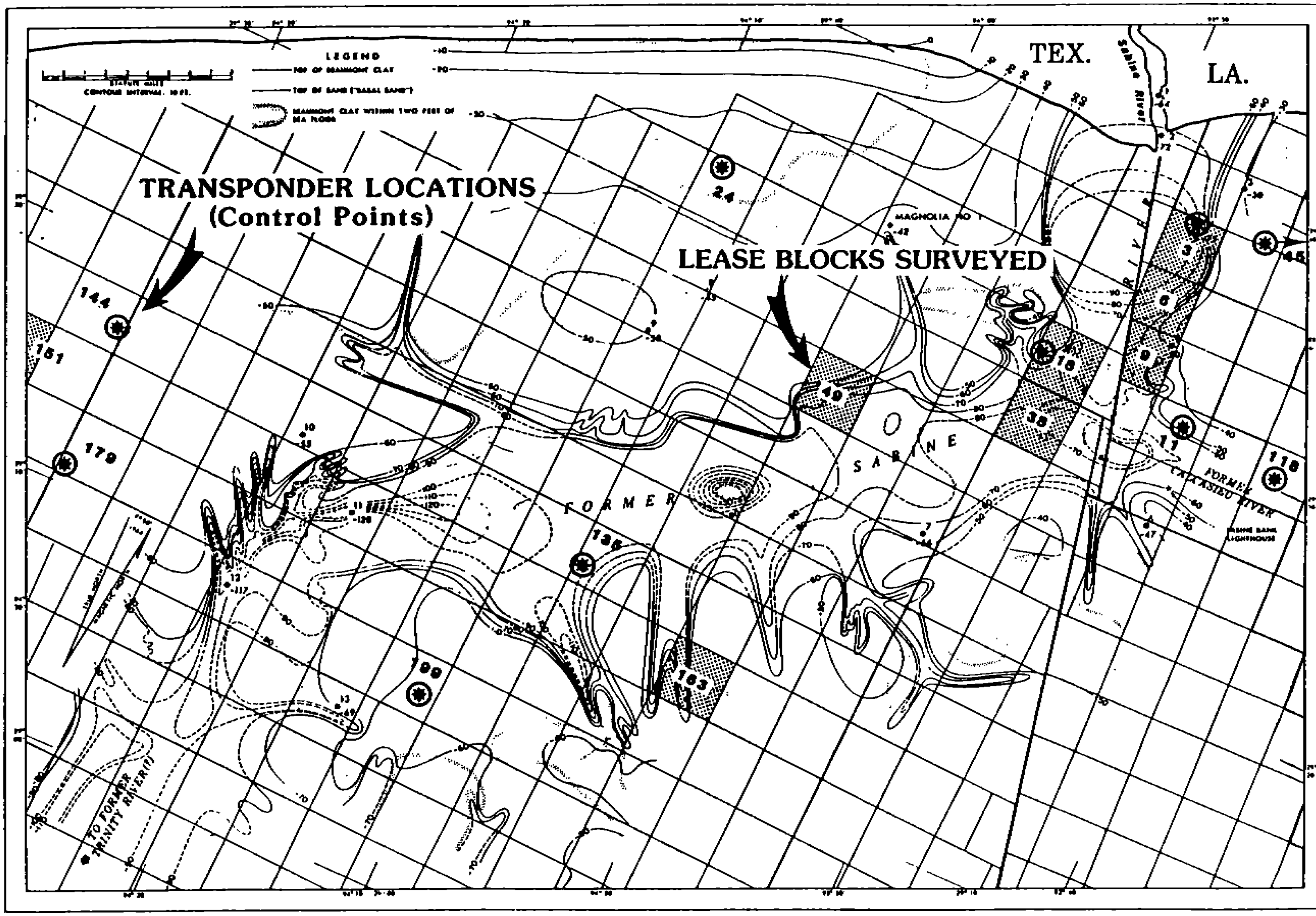

Figure IIIF.3 - The Study Area Showing the Lease Blocks Selected for Close Order
Seismic Survey

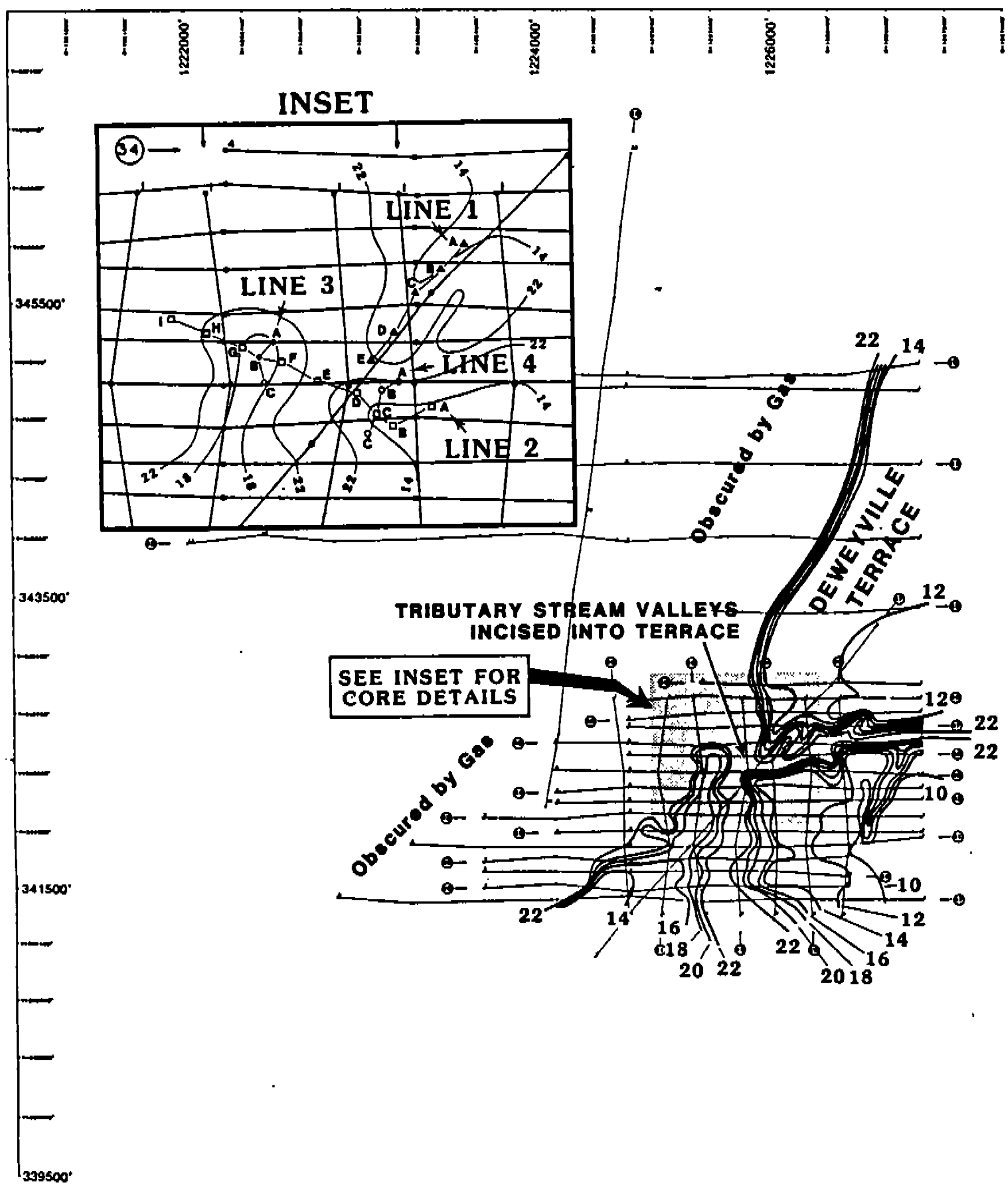

Figure IIIF.4 - Plan View of Pretransgressive Surfaces, Lease Block Sabine Pass 6